Full-Scope Site Level 3 PRA Project Status Briefing

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Background (1 of 2)

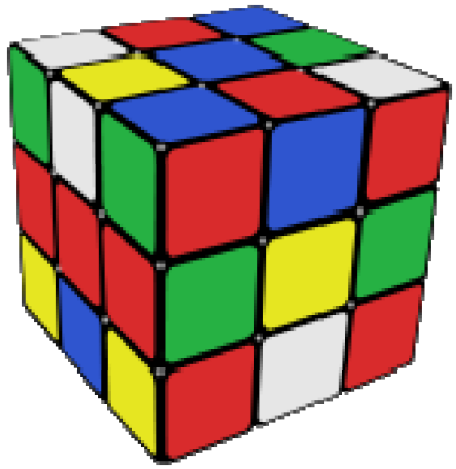
- Commission paper (SECY-11-0089), dated 7/7/11, provided options for undertaking Level 3 probabilistic risk assessment (PRA) activities
- In a staff requirements memorandum (SRM) dated 9/21/2011 the Commission directed the staff to:
  - Conduct a full-scope, comprehensive site Level-3 PRA
  - Provide annual briefings to Commission staff
- SRM-SECY-11-0089 also requested Staff's plans for applying project results to the NRC's regulatory framework (SECY-12-0123)
- SRM-SECY-11-0172 directed staff to pilot draft expert elicitation guidance as part of the Level 3 PRA project

Background (2 of 2)

- Radiological sources
  - Reactor cores
  - Spent fuel pools
  - Dry storage casks
- Project scope
  - All reactor modes of operation
  - All internal and external hazards (excl. malevolent acts)
  - Integrated site risk
- Quality reviews
  - Internal (self-assessment, Technical Advisory Group)
  - ASME/ANS PRA Standard based peer reviews
  - Advisory Committee on Reactor Safeguards
  - Independent expert reviews
  - Public review and comment

Outline of Technical Elements

- Reactor, at-power, Level 1
  - Internal events and floods
  - Internal fires
  - Seismic events
  - High winds, external flooding, other hazards
- Reactor, at-power, Level 2
- Reactor, at-power, Level 3
- Reactor, low power and shutdown (LPSD)
- Spent fuel pool (SFP)
- Dry cask storage (DCS)
- Integrated site risk



and

Project dimensions

- Radiological source
- Operating state
- Hazard
- PRA level

Project Status (1 of 3)

Project Infrastructure

Sept. 2011 – Nov. 2012

- Established Technical Advisory Group (TAG)
- Site selection
- Established communication protocols with SNC
- Developed and implemented staffing plan
- Developed and implemented contracting plan
- Developed Technical Analysis Approach Plan (TAAP)
- Provided Commission with initial plan (March 2012)
- Provided Commission with potential uses of Level 3 PRA project (SECY-12-0123) (September 2012)

Project Status (2 of 3)

KEY

Default – Reactor, at-power
LPSD – Reactor, low power and shutdown
SFP – Spent fuel pool
DCS – Dry cask storage

Amount of shading reflects degree of model completion

⇩

Model completion

⇧

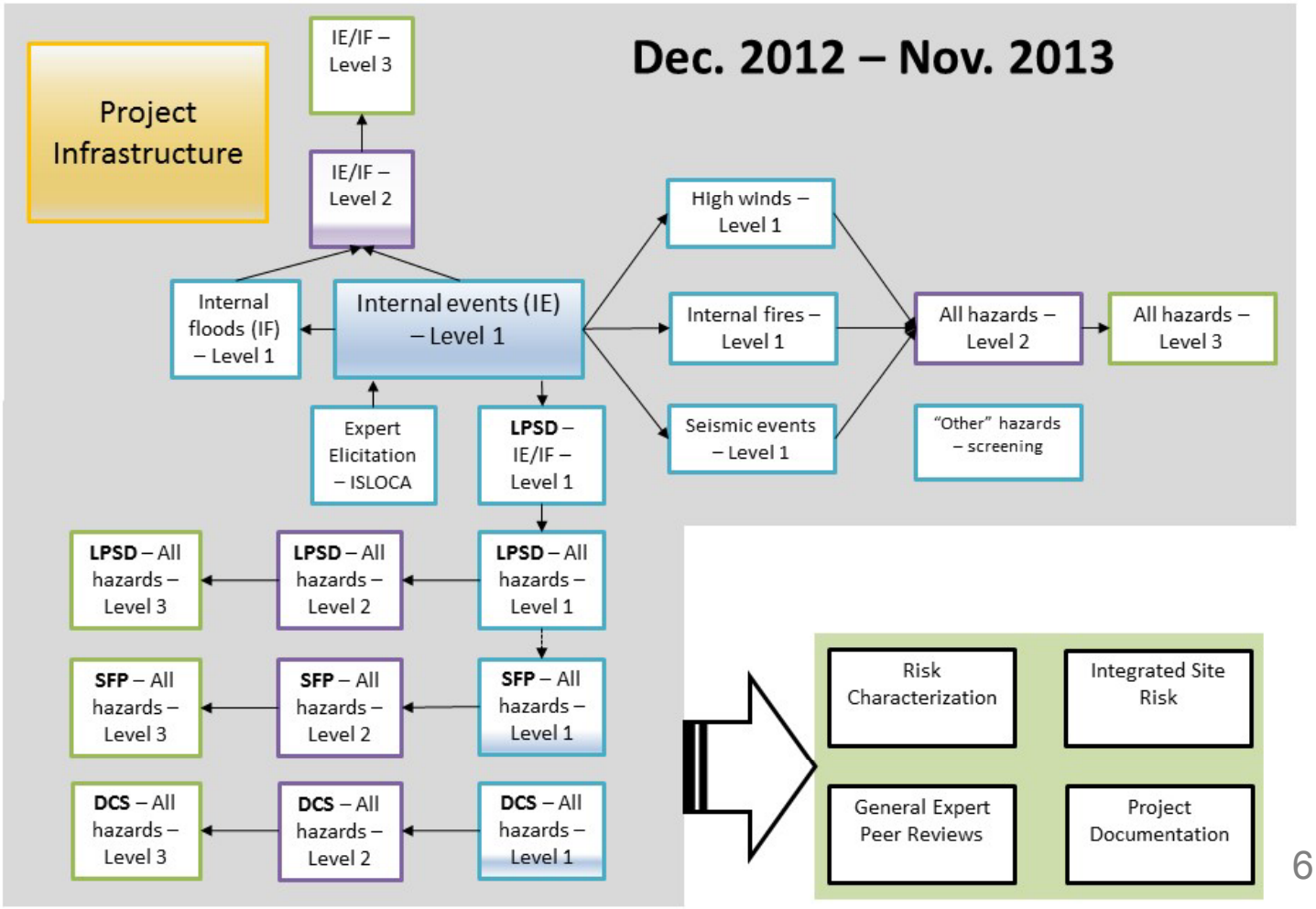
Bold border indicates peer review completed

Colors:

Level 1

Level 2

Level 3



Project Status (3 of 3)

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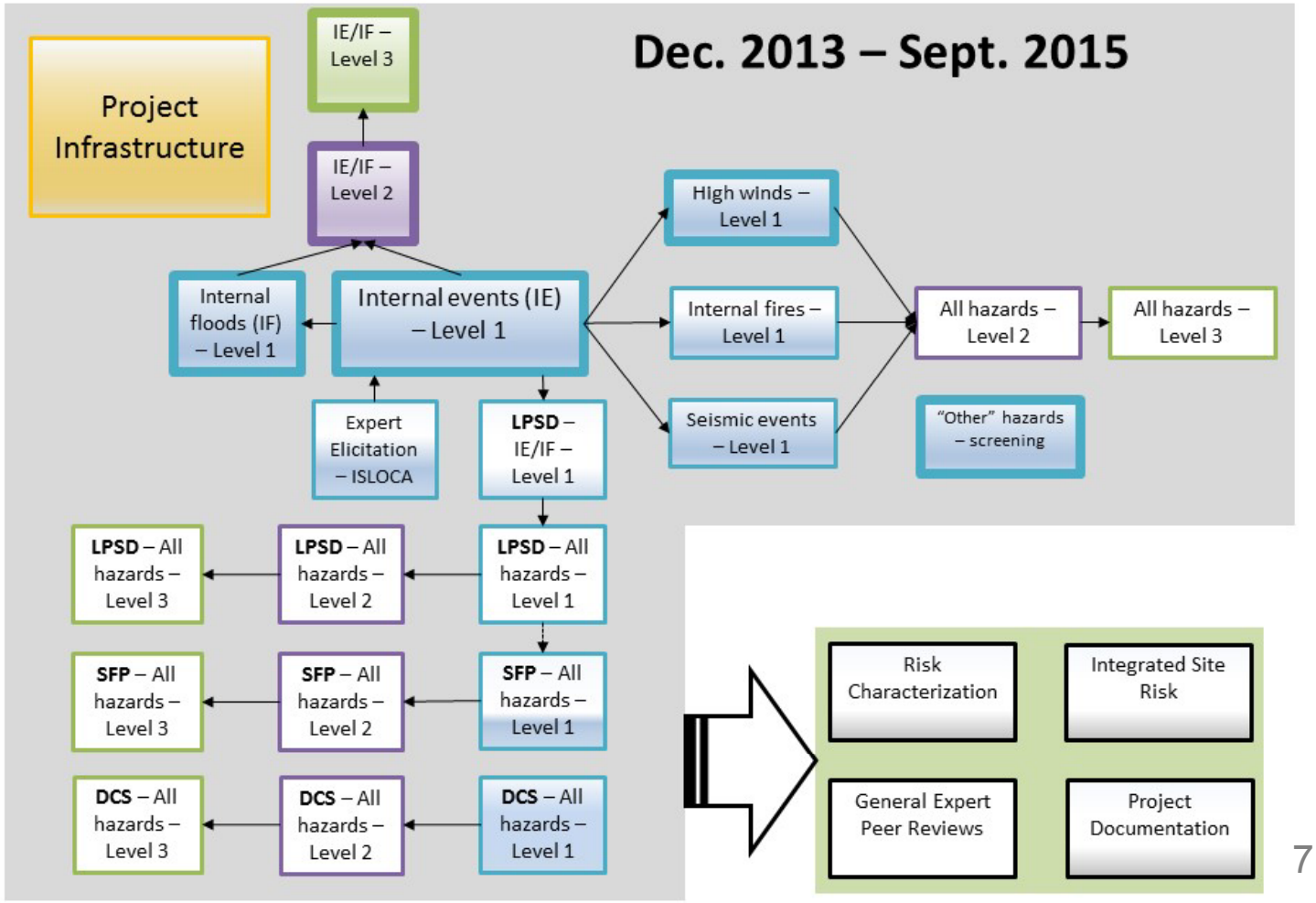


Major Accomplishments (1 of 2)

- Established robust project infrastructure
- Completed initial version of model and PWROG-led, ASME/ANS PRA standard-based peer review for:
  - Reactor, Level 1, internal event PRA
  - Reactor, Level 1, internal flood PRA
  - Reactor, Level 1, high wind PRA and other hazard screening evaluation
  - Reactor, Level 2, internal event and flood PRA

Major Accomplishments (2 of 2)

- Completed initial version of model for:
  - Reactor, Level 3, internal event and flood PRA
  - Reactor, Level 1, seismic PRA
  - Reactor, Level 1, internal fire PRA
- Developed draft peer review criteria for DCS PRA (PWROG-led workshop)
- Completed expert elicitation for frequency of interfacing systems LOCA
- Briefed Office Directors (Jan. 2015) and ACRS (Oct. 2014 and Feb. 2015)
- Held public meeting (Dec. 2014)

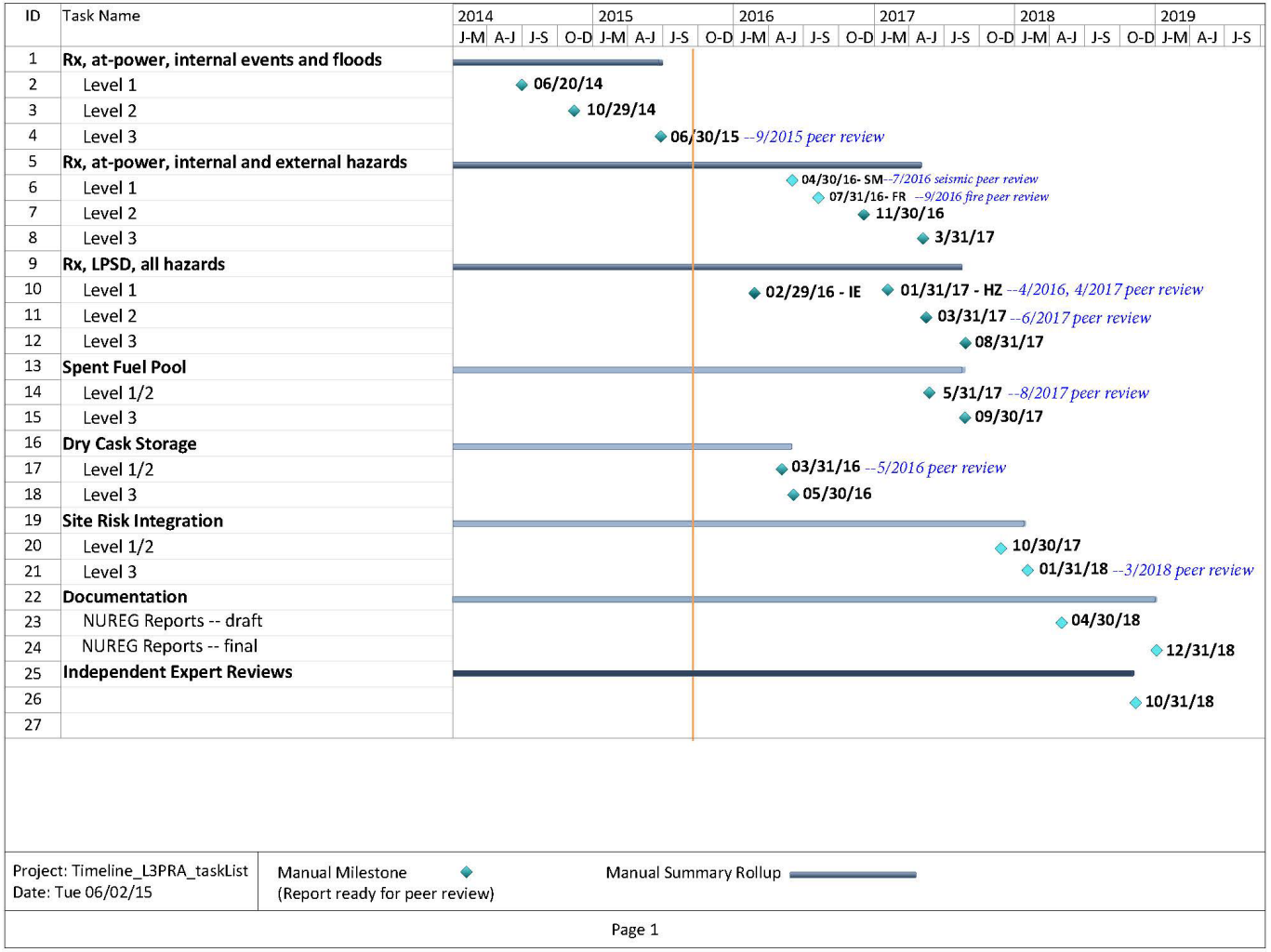
Upcoming Milestones

- Complete PWROG-led, ASME/ANS PRA standard-based peer review of reactor, Level 3, internal event and flood PRA (October 2015)
- Based on internal and external feedback, complete substantive updates to the following models:
  - Reactor, Level 1, internal event and flood PRA (November 2015)
  - Reactor, Level 2, internal event and flood PRA (March 2016)
  - Reactor, Level 3, internal event and flood PRA (June 2016)
- Complete initial models for:
  - Reactor, LPSD, Level 1, internal event PRA (February 2016)
  - Dry cask storage Level 1, 2, and 3 PRA (March 2016)
- Complete revised models for:
  - Reactor, Level 1, seismic PRA (April 2016)
  - Reactor, Level 1, internal fire PRA (July 2016)

Challenges

- Resources
  - Staff diversion
  - Availability of plant information
  - Level of effort to adopt licensee's peer-reviewed PRA models
- Dynamics of project
  - SNC's active PRA program for Vogtle (causing NRC staff to frequently reassess whether to update L3PRA models)
  - Iterative nature of modeling (after updating one model, need to update dependent models)
- Practicality and efficiency
  - Balance between completeness and consistency of Level 1 internal event trees and ability to efficiently exercise the model
  - Scope of PRA models for internal fires, LPSD, and integrated site risk
- Technical issues
  - Safe-and-stable state
  - Interfacing systems LOCA frequency
  - Relay chatter evaluation
  - Nuclear service cooling water modeling

Project Timeline



Project Benefits to NRC

- Updated understanding of reactor risk
- First look at risk to public health and safety for an entire site
- Enhancement to staff's capability in PRA and related technical areas
- Staff familiarity with industry PRA peer review process through participation on peer review panels
- Improvements in NRC PRA models and tools
  - SAPHIRE, MELCOR, MACCS
  - SPAR models
- Advancements in the state-of-the-art in PRA
  - Directly integrated Level 1 and Level 2 PRA models
  - Developed and implemented HRA approach for post-core-damage response (e.g., severe accident management guidelines and extensive damage mitigation guidelines)
- Pilot application of NRC's draft expert elicitation guidance (per SRM-SECY-11-0172)

Project Benefits to Nuclear Industry

- Reduce barriers to use of PRA for holistic risk management
  - Broader NRC staff acceptance of PRA methods
  - Establishment of a baseline for PRA methods that can be used by industry, to reduce uncertainty in acceptability of PRA models used for risk-informed applications
- Better NRC staff understanding of the peer review process and appreciation for the level of effort required to develop, document, maintain, and update PRA models
- Trial application of, and improvements to, draft ASME/ANS PRA standards
- Better risk insights into public health and consequence associated with nuclear power plants using updated tools and better understanding of severe accident phenomena (e.g., updating our understanding since NUREG-1150)
- SNC access to Vogtle PRA models created for the project that could then be used as the starting point for their own Vogtle models (e.g., reactor Level 2 and Level 3, spent fuel pool, dry cask storage)

Concluding Remarks

- Very broad project scope
- Substantial progress is being made in many technical areas, including going beyond the state-of-practice in some cases
- NRC has already reaped benefits from the project, with many more to come
- Substantial challenges remain, especially NRC and contractor staff availability
- Project schedule has extended 2-3 years
- Acknowledgements
  - Southern Nuclear Operating Company (SNC) – Extensive resource commitment to provide plant information, support plant visits, and review project documentation
  - PWR Owners Group – Support for ASME/ANS PRA Standard based peer reviews
  - Westinghouse and EPRI – Support for Technical Advisory Group